WHERE DID THE 'NEW URBAN ECONOMICS' GO AFTER 25 YEARS?

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Paper to the
38th Congress of the European Regional Science Association
Vienna
28 August-1 September 1998.

ABSTRACT

The notion of the 'New Urban Economics' emerged in the late 1960s as more rigorous approaches were applied to what had largely hitherto been an essentially descriptive approach to analyzing urban economies. The application of mathematical methods to urban problems offered the prospect of both a more thorough understanding of how urban economic systems function and a basis upon which frameworks could be developed for quantitative testing of alternative ideas. The aim of this paper is to examine the extent to which this new approach has lived up to initial expectations and degree to which modern urban economics has managed to circumvent some of the earlier criticisms raised against it. It also assesses the extent to which the new urban economics has fulfilled its promise of allowing greater quantification of urban parameters as aids to policy making.

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1. Introduction

Not only are economists dismal, they are also introspective. In 1991 the UK's Royal Economic Society celebrated its centennial by publishing an issue of the *Economic Journal* containing a series of short reflective papers by leading economists. These sought both to review the current state of economics and to look forward to consider where the subject may go[1]. A theme common to many of the contributions was the role of mathematics, and especially mathematical modeling, in economics. No consensus emerged as to how useful it currently is or the extent to which it will play a role in the future development of the subject.

The Nobel Laureate, Wassily Leontief (1982) argued that economics had deteriorated into a second-rate branch of mathematics in which, unscientifically, researchers eschew empirical investigation. Morgan (1989) points out that while about 12% of physics papers and virtually all chemistry articles use data only about half of economics papers do. Oswald (1991), after examining the contents of the Economic Journal over time concludes, "…economics is in an equilibrium in which large numbers of researchers treat the subject as if it were a kind of mathematical philosophy. I find it hard to believe that this is a desirable state of affairs".

On the one hand Friedman (1991), ever the pragmatist, takes the view that mathematics, "has greatly extended the power of economic analysis, but is often used to impress rather than inform. Results that might have been attainable only by sophisticated mathematics can nonetheless be explained in understandable English. Again and again, I have read articles written primarily in mathematics, in which the central conclusions and reasoning could readily have been restated in English, and the mathematics relegated to an appendix making the article far more accessible to the reader".

There are, however, no shortage of counter augments Hahn (1991) for instance, contends that ,. "I do not share the view that pure theory is scholastic and so by implication bound to be irrelevant to the world".

What have these debates to do with urban economics? In the old days very little. Urban economics until the early 1970s had tended to be highly institutional and was often policy driven (Richardson, 1976). Subsequent changes involving the combination of welfare economics and mathematical methods have profoundly changed the subject matter of urban economics (Richardson, 1973). This is not a trend unique to the sub-discipline and it is to be found in virtually all branches of economics as Friedman's analysis indicates. The focus here,

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[1] Milton Friedman (1989) did his homework and found that there were no mathematical symbols in the first volume of the *Journal*, there were symbols on two pages of the second volume and one in the third. Subsequently the number of pages rose but in total there were only 70 pages in the initial ten volumes. The growth in mathematification, was, though, uneven and in 1930, for example, there was only one page of mathematics.

however, is to examine the so-called 'New Urban Economics' (NUE) some 25 years after Mills and MacKinnon (1973) first introduced the term[2].

In the early 1970s, a variety of authors such as Beckmann, Muth, and Mills began developing mathematical models to explain the growth dynamics of simple urban forms. These urban areas are typically characterized by having one single place of employment at the center surrounded by residential places from where people commute into the central business district (CBD). The assumption of a single transport mode is common. These models have inherent limitations because for their analytical power they rely upon very restrictive assumptions; they tend to limit applicability to the abstraction. Their isolation from reality would seem to be particularly true in the 1990s, when metropolitan areas are in a state of reformulation. No longer is the CBD the only place one may find gainful employment. No longer are suburbs simply places for residential quality of life and low-order retail (grocery stores, gas stations, etc.).

In the 1990s, for example, a new economic entity emerged and been brought to public attention through the publication of Garreau's (1991) *Edge City: Life on the New Frontier*. It describes the decline of the CBD and the rise of the suburban employment center (edge city), and notes how the edge city is changing the very nature of the look of urban areas in the US. Edge cities are suburban employment and commercial nodes that in the 1990s are having as great an effect on suburban life as malls did just twenty or thirty years ago. The general aim of the paper is to provide an assessment of what has happened to the NUE over the past quarter of a century but, in order to make the task tractable, to do so in the context of the emergence of edge cities.

The paper proceeds in stages. First, it outlines the growth and development of the NUE school of thought. Second, it describes what edge cities are and how they interact with the rest of the urban area. This part will also look at the broad employment and industrial trends of US metropolitan areas in the 1990s. Finally, the paper analyzes the problems NUE has in dealing with edge cities and ascertains if NUE may be able to cope with the new functional form of cities.

2. A Brief History of the New Urban Economics

NUE is a subject of inquiry that has been evolving over the past twenty-five years, and its development may be characterized by four stages of inquiry: the precursor phase, the development phase, the extension phase, and finally in the 1990s the challenge phase. From its earliest stages NUE, much like regional science as a whole, has borrowed from a variety of disciplines[3] to form its theoretical and empirical foundations; as such, the number of direct and indirect contributions to the school of thought are myriad.

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[2] Although many trace the evolution of the approach back to Beckman (1969). The term itself continues to be used although the appraoch to analysing urban problems has become rather long in the tooth (Richardson *et al* 1996). The term 'Analytical Urbvan Economics may now be more appropriate but we stay with the older terminology in this paper.

[3] Although not delineated specifically, the theory has a heavy emphasis in economics, geography, spatial systems, and political science.

The Precursor Phase – Analysis of Space

A few key authors influenced early thinking on what subsequently became the NUE. Although the economics discipline has the habit at times of ignoring the impact of space, three influential authors realized the importance it in the description of local economies. Each of these precursors described systems where there was a great deal of interconnectedness within local and national economies, and it is through this that their models gain their power. The first author who arguably laid down the basis for all subsequent work in regional science is von Thünen (1826).

This work, which was subsequently extended into a non-agrarian setting by Lösch (1939), focused on production location decisions as largely a transport issue. If there is land of equally productive value for growing agricultural products (an example that von Thünen suggested) around a central marketplace, the price of the land can be defined as a gradient with its price decreasing as distance increases. Farmers, who could produce goods that either fetch a high price or do not take much land to grow, would tend to buy more expensive land closer to the marketplace. The opposite is true for land farther out in the hinterland. As such, this might be called the even suburban development theory. According to the theory all land surrounding the central business district, where all commerce is traded, is equally productive. Farmers would only purchase land based on the transport costs to market. For certain agriculture products, like fruits and vegetables that tend to spoil quickly, being located closer to markets would be more important than for arable farmers growing less perishable crops wheat or oats.

Even suburban development theory argues that as the metropolis grows, the hinterland will be filled out evenly, beginning with the closest land to the center. The development will be characterized by a set of concentric circles around the CBD that represent the various rent gradients. More than any other single theory, this idea perpetuated the smooth rent function assumed in many spatial models today.

Nearly one hundred years after von Thünen, Hotelling (1929) discusses a linear economic system that is often described in pedagogical settings as two ice cream vendors on a beach. That is, two suppliers are selling a completely homogeneous product in terms of both price and quantity. As they have a cart from which they vend (or some other highly mobile facility), each may locate anywhere on the beach. Since there are individual consumers distributed evenly along the beach, there is no net benefit to locating at any one particular place, except to be closest to the maximum number of customers. The two ice cream vendors will jockey for position along the beach in order to be closest to the maximum number of customers. Although the socially optimal position of the two vendors that minimizes the average walking distance of purchasers would be one-quarter of the way down the beach and three-quarters of the way down, respectively, the equilibrium position would be very different, with each vendor being next to each other at the midpoint of the beach[4].

This simple linear economy demonstrates the spatial dependence of actors in local commerce, and how the action of one has spill-over effects on the other. Of the spatial models that are subsequent to Hotelling, this spatial dependency theory tends to follow.

After the even concentric development theory of von Thünen and the linear economy of Hotelling, Christaller in 1933 developed his nodal hierarchy theory. Christaller noted that

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[4] An expanded discussion of Hotelling's 'Stability in Competition' article, complete with diagrams, may be found in Higgins and Savoie (1995). It should be noted that although there is stability with two vendors, increasing the number to three creates a permanent disequilibrium, assuming no collusion among the competitors and only one dimensional space.

there existed in Southern Germany an urban hierarchy where cities were defined by the kinds of markets they supported. In the largest and most central cities in urban areas the most expensive goods may be purchased. There are then a set of secondary smaller cities distributed around the central city that sell goods purchased on a weekly basis. Finally, interspersed among those secondary cities are smaller hamlets that sell day-to-day products and services. Thus, the organization of cities is dictated by the markets of goods, where relative size of the city is a function of the kinds of consumer goods sold[5].

The Development Phase
Although a number of authors influenced thinking about the NUE, including Alonso (1964) and Muth (1961), the paper that brought the NUE to the forefront was Beckmann's 1969 *Journal of Economic Theory* article. It is set apart from other papers of the era because it discussed the basic parameters for the simplest urban form, and how mathematics modeling can begin to help describe the dynamics therein. Beckman posits that:
- The central city is located on an isotropic plane.
- All employment is located at the center of the city in its central business district.
- The city is connected by a densely packed network of radial transport links that facilitate transportation from the hinterland into the CBD. The network allow for any individual at the same radius to traverse the distance to the CBD equally well. Land rents are thus based solely on distance from the CBD.

On these assumptions, Beckmann argues that the market for housing is determined by the amount of space physically occupied and the distance from the CBD to which an individual commutes. Through a series of mathematical derivations[6], he concludes:
- Wealthy individuals will locate relatively far from the CBD so as to enjoy more living space.
- The land area of the city will grow more slowly than the population, because there is a tendency for cities to 'fill-in' rather than simply expand its borders ('packing').
- . The model implies a rent gradient that decreases, *ceteris paribus*, as distance from the CBD increases, which is why people might be interested in more living space in the suburbs.

The theory is essentially grounded in the von Thünen model, where rent gradients are simply a function of distance from the central place. The only major differences are that the Beckmann approach is based in mathematical modeling and second, that instead of agricultural products located in the hinterland being the focus, it is labor. The rent gradient that one might expect with this model would be a smooth curve that declines precipitously from the city center outward. The power of the model lies in its general simplicity in explaining simple urban dynamics, even though the model could be criticized for having a large number of assumptions that can make it too unrealistic.

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[5] Berry (1967) elaborated and extended on Christaller's idea; since it is very similar in theory it is not separated for discussion here.

[6] Since this article, like many of the seminal articles in the NUE field, may be found in a recent edition of the *Modern Classics in Regional Science* collection (Richardson *et al*. 1996), the equations will not be duplicated here. Only the theory and ideas behind them will be explored.

The NUE essentially became a distinct school of thought was mainly through two early symposia on analytical urban topics that were published first in the *Swedish Journal of Economics* in 1972 and in the *Bell Journal of Economics* in 1973. In these symposia, articles were written on transportation issues (Solow 1972; 1973), city size optima (Mirrlees 1972), and efficient resource allocation (Mills 1972). At the time of the *Bell Journal* symposium, there were, "probably close to two dozen contributions to the new urban economics" (Mills and MacKinnon 1973)[7].

The Expansion Phase

The original model was almost too simplistic. It argued an urban setting that had not really been true for over a hundred years even in geographical conditions consistent with the modelling assumptions. In particular, the empirical evidence increasingly showed that not everyone lived in the suburbs and commuted inward, and further, there is no reason to believe that all employment must take place in the center core. Strictly homogeneous tastes and preferences across all individuals in the region is also unlikely. Other elements of the production side modelling were inadequate with a common reliance on a three sector economy; housing transport and production with the latter only involving a single sector with output being produced under conditions of constant returns. Many models had employment determined exogenously.

The subject area of the NUE, however, tended initially to widen out rather than to relax the main assumptions of the early work. A variety of papers were written to supplement the original set of models, and they dealt with a variety of not only economic but social topics such as the role of racism (Rose-Ackerman 1975, Kishimoto 1991), heterogeneous tastes and incomes (Hochman 1981, Roback 1982, Beckmann and Papageorgiou 1989), differential transport modes (Sasaki 1989), Tieboutian local fiscal effects (Ellickson 1971; Hochman 1981), and urban dynamics (Anas 1978; Braid 1988). Each of these dealt with a partial equilibrium issue based on the interest of the paper[8].

A major area of interest was the consideration of externalities such as congestion and in modeling various subsidy and taxation strategies to bring about quasi-internalisation. User on non-user externalities, especially regading environmental effects, however, received less attention although zoning models have some relevence. Where explicit efforts have been made to introduce environmental considerations they have ofetn been rather simplistic in their nature9.

The On-going Phase

The most recent focus in developing NUE models is to embrace the subtleties of non-monocentricity. It is clear that in reality not all employment is at the urban core and that commuting is not uni-directional. There has historically been some effort to develop discrete models but these never really attracted much attention. White (1976) had a sub-center in her model with its existence being brought about because it is effectively separate from the core and benefits from such things as lower freight rates and wages. Wieand (1987) allowed for

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[7] Richardson 1976; 1977, offer integrated accounts of the development of developments in the NUE to that time.

[8] Many of these ideas were brought together in a retrospective article by Richardson (1988).

[9] Mirrlees (19720 had earlier used population density as a proxy but subsequently Roback (1985) embraced clean air, low crime and a good climate as environemntal attributes.

reverse commuting in his framework with labor catchment areas providing the rationale for sub-centers. The model is also important in that individual developers are responsible for sub-centers.

With the advent of Garreau's 1991 book *Edge City: Life on the New Frontier*, there became an awareness that urban areas were changing. Even though Garreau was not the first to realize that urban areas were defined more by nodes than by the CBD employment center and suburban residences, he both coined the term and described their characteristics.

Edge cities are defined as suburban places exhibiting the following five major characteristics (Garreau 1991):

- Edge cities have at least 5 million square feet of leasable office space (usually most of the space is high-end corporate quality).
- They have at least 600,000 square feet of retail space.
- The daytime population increases in edge cities. That is, more people work there than live there.
- They tend to exhibit characteristics that have traditionally be held only by the old downtown: an end-use nexus of jobs, retail, and entertainment.
- The edge city must not have had such an urban character as recently as 30 years ago. Edge cities are a recent phenomenon.

These characteristics provide the critical mass needed to enjoy the local benefits of agglomeration economies. Based on these criteria, there are thirty metropolitan areas and 118 fully constituted edge cities in the United States. A US metropolitan area with edge cities may be home to as few as one, or as many as 17 distinct edge cities.

As manufacturing employment continues to decline in the United States[10], giving way to the so-called 'Third Wave' (Toffler 1981) information and services economy, the hinterlands tend to enjoy significant levels of employment growth while the CBDs decline. Stanback (1991) recognizes that this suburban growth is seen in most industries; however, business, social, and consumer services are growing especially faster than total employment growth in many suburban counties. Within some of these new agglomerations, economic activity has emerged; the causes and consequences of which are theorized, but not much empirical work has been undertaken to test the postulates[11].

Recent theories on suburbanization and urban development (irrespective of any direct ties to the NUE school of thought) have attempted to determine the push and pull effects that impact the flight away from the CBD of individuals and businesses. Mieszkowski and Mills (1993) argue that suburbanization is a response to a kind of 'natural evolution' of cities and urban structure as the metropolis ages. They find that at the same time a 'flight from blight' hypothesis has tended to accelerate suburbanization. People and businesses thus leave the

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[10]   Total employment in all manufacturing industries declined 4.3% between 1987 and 1992 while overall productivity (as measured by total value added by manufacturer) increased 22.2% during the same timeframe (U.S. Department of Commerce, Bureau of Census, 1997).

[11]   Mills (1992) described a variety of potential reasons to have inter- and intra-metropolitan clustering. Although not explicitly termed 'edge cities,' intra-metropolitan clustering elicits the same vision of suburban agglomeration articulated by Garreau (1991). Also, Hartshorn and Muller (1989, 1992) have discussed the rise in what has been termed 'suburban downtowns.' Finally, Henderson and Mitra (1996) have analyzed the development of the edge cities themselves.

central city in order to enjoy an improved quality-of-life, free from the problems of crime and urban decay that seem to plague the inner city[12].

Mieszkowski and Mills argue that not only do certain fiscal issues (*vis-à-vis* Tiebout 1956) push economic actors out of the city, but they also hamper central city redevelopment. The impact of taxation and expenditure policy on industrial location is hotly debated. Although authors such as Vedder (1981) have theorized that taxes should have an impact on the location decision, most econometric studies have not supported this contention (Erickson and Wayslenko 1980, Newman and Sullivan 1988).

One of the important characteristics of edge cities is their proximity to highways and other major thoroughfares, and much of the suburban nucleation literature focuses on access to transportation systems. Indeed, Erickson and Gentry (1985) argue that such suburban agglomerations are driven specifically by transport, since roads and highways create linkages between the various nodes in the metropolitan landscape. They argue that suburban transport systems facilitate industry around the city just as radial roadways facilitate commerce in the CBD[13]. In the Dallas area of the US, for example, edge cities are around the Interstate 635 loop or Stemmons Freeway (Highway 75). In the Washington area, the largest of the edge cities, Tyson's Corner, is at the intersection of the Capitol Beltway (Interstate 495), Route 7 – Leesburg Pike, and Route 123.

As suburban nucleations have increased, the relative importance of the CBD has diminished (Erickson 1986). Firms, then, have taken advantage of these new economies of scale and access to skilled labor (Erickson and Wasylenko 1980) and have been suburbanizing at an increasing rate over the last several years (Jones 1991). Historically, the cost of locating in the suburbs has been lower than in the CBD, a suburban advantage that seems to be waning as time passes (*Economist* 1989). Additionally, some empirical evidence suggests that inner-city establishments are less profitable than comparable suburban ones (Dobson and Gerrard 1991). Finally, the rise in information and communication technology has also tended to increase the rate of suburbanization, especially in the US (Chinitz 1991), a trend consistent with the so-called 'third wave' economy (Toffler 1981).

With all this activity in the suburban fringes, the question has been posed as to whether or not the suburbs are at all dependent on the city (Bingham and Kalich 1996). The suburban dependency hypothesis argues that the health of the entire region (including the edge cities) is inexorably linked to the health of the city. Even though this city/suburb dichotomy seems partisan, most authors agree that the two need each other, (Lang 1992; Gurwitt 1992; and Center for Economic Development and Research 1990). Beyond theoretics, this idea is supported on an empirical level (Voith 1992). A long-term decline of the city seems to have a decided impact on the region as a whole. This love/hate relationship indicates that the suburbs cannot live with, but also cannot live without, the suburbs. That stated, however, Bingham and Kalich (1996) conclude that the center city needs skilled suburban labor more than the labor needs employment in the CBD.

Of the challengers to the monocentric NUE, White (1976) argues that there could be a rent gradient that peaked twice, once at the CBD and then at the secondary suburban employment center. These employment sub-centers may be planned so that utility can be maximized for all in the urban area. The problem with this analysis is that economies in the

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[12]   Such evidence is bolstered by recent data on the causal relationship between crime and income by Johnson (1997).

[13]   This braod modeling approach can be traced back to Babcock's (1932) concept of the axial city.

U.S and many other countries are not planned by any central or regional agency. Rather, they grow and develop through a level of 'ordered chaos[14].'

The history of edge cities seems to run counter to the notion of monocentricity and to the original NUE theories. Perhaps, then, NUE theory is not sufficient to explain the development of large suburban cities that can rival the metropolitan core. The sentiment of Schneider and Fernandez (1989) would then be appropriate, "Economic activity must occur *somewhere* – it has a geographic distribution that may be highly uneven."

Stanback (1991) argues that data show a trend of stagnating central cities in the US where the suburban fringe as well as smaller, fast-growing central cities are the beneficiaries. Indeed, net overall employment growth in 14 of the largest US cities[15] in the central jurisdiction between 1969 and 79 was only 0.76% while it was 3.49% in the suburbs. Similarly, between 1979 and 1987 the central cities and suburbs grew at 0.94% and 3.41% respectively. While urban cores around the nation are stagnating at best, the suburbs are flourishing.

Problems with the New Urban Economics Model

The NUE model is an intuitive one: cities have historically seen as places to live and work, with the suburbs being merely secondary retail centers and bedroom hamlets, consistent with Christaller (1933). Edge cities diminish the utility of the NUE model by arguing that suburbs can be not only places to reside, but also to work at high-paying jobs. There are a number of problems with using derivatives of the NUE model to explain current urban development trends:

Krugman's Self-Organization Simulations
Krugman (1994) discusses an extension to the NUE model that could simulate and incorporate edge city employment concentrations, something that had not been explicitly done in the earlier literature. He argues that urban systems are dynamic processes whereby from chaos comes order, or what he terms 'self-organization.' His model has the standard, although somewhat unrealistic, assumptions of homogeneous housing developments, but for this simulation, all activity resides on a tightly packed ring. Under this scenario, the area within the ring may not be a factor in the location of the edge cities. He then argues that two criteria are necessary conditions for the self-organization of edge cities to occur. There must be both centripetal and centrifugal forces. That is, there are both push and pull effects of agglomeration and diffusion at work in the distribution of business commerce around the ring. From these two criteria, edge cities will behave fairly consistent; they will be evenly spaced entities around the ring as far away from each other as possible. In his two sets of simulations, he estimates commerce that is evenly distributed around the ring will agglomerate into either two or four distinct edge cities, perhaps as they are spaced in Figure 1.

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[14] This is the general sentiment in Krugman (1994).

[15] Including New York, Chicago, Philadelphia, Los Angeles, Atlanta, Boston, Cincinnati, Columbus, Dallas, Detroit, Minneapolis, Pittsburgh, St. Louis, and Washington. This statistic is taken from Stanback (1991).
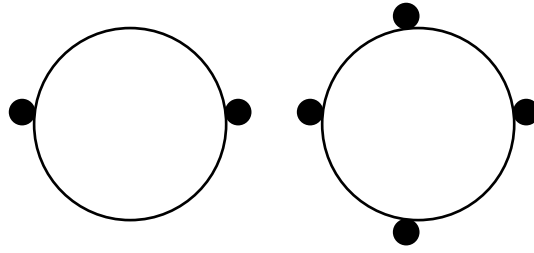
Figure 1. Hypothetical Position of Krugman's Edge Cities

What is problematic about this organization is that edge cities are rarely structured this neatly around a central place. Take for example the case of Dallas/Fort Worth. Most cities identified by Garreau are positioned in the northern regions of the metro area. None are within the southern part of the Metropolitan Statistical Area.

One would assume that if there are major geographical impediments to locating in any one particular area, such as mountains, lakes, and the like, that might be a compelling reason to have uneven growth. In the case of the Dallas/Fort Worth area, there are no such impediments. One might also assume that this uneven edge city phenomenon is isolated in a few instances; however, this is not the case. Metropolitan regions such as San Francisco/San Jose/Oakland, Austin, Charlotte, Cleveland, Denver, Kansas City, Memphis, Miami, Orlando, among others have some level of unevenness in edge city development. Krugman, then, is a good point of departure in thinking about the growth and development of these edge cities, but the simulation power of the procedure to estimate where and when edge cities will develop is suspect.

One might argue that the Krugman model still has validity because it could be maintained that it is only a matter of time before other edge cities grow to balance out the dispersion of the original edge cities. Although basic spatial economics might resolve this quandary by arguing that less expensive land rents in the southern part of Dallas, for example, might be competed away over time, Krugman argues that one of the basic tenets of self-organization is the simultaneous nature of edge city development. It is this simultaneous development that is key to the Krugman analysis, since without it the model would tend to lose its intuition.

Monocentric Models Lack of Realism

Abstractions in models such as those used in NUE are important to describe the dynamics in economic systems. The real question that these models tackle was posted about ten years ago by Richardson (1988), "The purpose of a model is to simplify reality so as to highlight key phenomena. However, there is a question of how far the model can distort reality before it ceases to be relevant....This is an important question to be put to the standard monocentric model of urban land use that has dominated urban economics, and urban models within regional science, for a generation or more". The *prima facie* criticisms of the model are three-fold:

- No urban area of note is monocentric.
- NUE ignores political and institutional issues that can easily disrupt NUE equilibrium.
- The introduction of edge cities corrupts the standard model.

This first criticism of NUE is likely the most damning. According to data from the Bureau of Economic Analysis, by 1980, only about 8% of total urban employment was in America's CBDs. So long as the balance of total regional employment is scattered randomly throughout the hinterland, the NUE model can cope with this, since one may still calculate the decreasing land rent gradient. With the advent of suburban office parks and industrial districts over the past few decades, certain key areas around the urban core have begun to exhibit suburban agglomerations, that reek havoc on standard NUE models.

Some authors have attempted to deal with problem by infusing the model with multiple centers (Wieand 1987; Yinger 1992). These models, although closer to reality than the classical NUE model, have the problem of only incorporating one more urban agglomeration[16], and as noted in *Edge City*, the number of significant agglomerations may be as high as 18 for the largest metropolitan areas.

In the analysis of urban subcenters, Hartshorn and Muller (1986) best discussed the transformation of the American suburban hinterland by writing, "With surprising speed in the 1970s and 80s, suburbs have evolved from a loosely-organized 'bedroom community' into a full-fledged 'outer city,' characterized by metropolitan-level employment and activity concentrations and functional shifts that amount to nothing less than the achievement of suburban economic, social, and geographic independence from the nearby central city."

They further discuss suburban agglomerations in three metropolitan areas, noting that these 'suburban downtowns', often rival the amount of total office space in the CBD. In Atlanta, for example, there was roughly 13 million square feet of office space in the CBD, but in the Cumberland/Galleria area there was 14 million square feet and in the Perimeter Center there was 16 million square feet of office space. Results from the other urban areas revealed similar trends. These edge city or suburban downtowns contribute significantly to the regional economy, and therefore omitting the effect of these suburban nodes from NUE models mistakenly describes urban economics.

As a corollary to the policentricity of urban areas, political and institutional issues can confound the NUE model. With the rising economic power of the suburbs, local public administrators and policy makers are taking an increased interest in their own economic development issues. The increased use of tax abatements, free and low cost loans, education and training grants, and the like by local governments to encourage firms to locate within their borders can reinforce the nodal polarization of urban areas. A single, ambitious suburban county or city may offer a number of incentives to induce firms to locate in their jurisdiction, yielding a non-equilibrium solution since market economics is non-operational.

Consider some practical examples. Without heavy investment by both the state of North Carolina and local governments, the Research Triangle Park area in the greater Raleigh/Durham/Chapel Hill area is unlikely to have developed. Similarly, the greater Phoenix area is replete with edge cities that have been historically planned nodes by government[17]. Edge cities are also outgrowths of office parks, which may be planned by either governments or private developers, as in the case of the Denver Tech Center. Edge cities might not have developed at all if it were not for the government intervention, and such an effort is difficult to incorporate into NUE models .

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[16] These models either argue that there is a second urban core (Wieand 1987), or that there exists an 'urban' region and 'suburban' region on competing ends of the metropolis (Yinger 1992). Although more realistic than the original NUE model, the models still lack a level of realism.

[17] For an expanded discussion of the planned edge cities in the Phoenix area, see Garreau (1991).

Finally, the monocentric model is unrealistic because the existence of edge cities corrupts the model to the point where it loses its overall utility. With land gradients, a monocentric urban place will yield a fairly well-behaved decreasing rent curve; as distance increases from the CBD, *ceteris paribus*, so do land rents. When there are agglomeration economics at work in edge cities, however, there is a new dynamic involved. Since firms will want to be near the edge cities, land rents will take that into consideration, yielding a multi-peaked rent gradient, as in Figure 2.
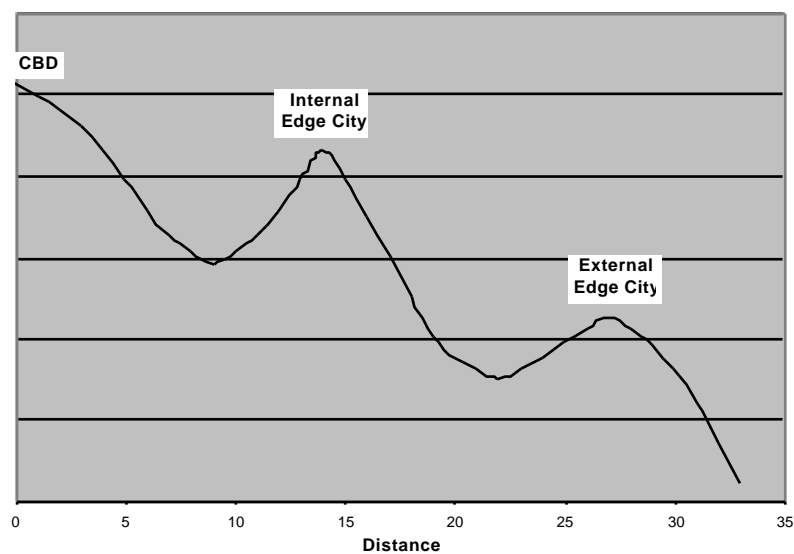

Figure 2. Hypothetical Rent Gradient Curve with Edge Cities

Any NUE-type model would then have to incorporate two dynamics. First, the decreasing rent gradient emanating from the CBD, followed by the interaction effect of increasing rent gradients to the edge city. This complicates the standard NUE model such that no author to date has found a way to incorporate several edge cities into an urban model. Such a model may be so complicated as to make it virtually intractable.

Conclusions

This discussion of the NUE and edge cities begs the question of what is the utility of the NUE approach? New Urban Economics was the first analytical method used to identify some of the dynamics of urban economics. As such, it has developed an abstraction of analyzing systems that are consistent and well-behaved. Indeed, in the early 1970s, many of the NUE assumptions held to a greater or lesser degree. With the advent of the 21st century, though, the classical NUE model may bring fewer insights to the urban economics discussion especially with regard to the US and other mature economies. No longer do all, or even a significant percentage of, people work in central cities. The so-called 'third wave' information technology revolution has made the necessity of living and working in central cities obsolete. Edge cities in several areas are employing more people than central business districts, and are growing as CBD stagnate or decline.

That said, NUE may have some applicability in certain second and third world nations that are just now in the process of industrializing and forming cities, although here high levels of congestion at the core combined with the rapid up-take in many cases of service driven industries means that many of the traditional NUE assuimption may not prove durable..

The ultimate question then becomes can the NUE methodology be adjusted to take into consideration recent economic and demographic trends. Although the ultimate answer to this question is left to the economic theorists, the probable answer is no. It seems that edge cities were sired out of chaos brought into order, and as such may not be modeled with any level of confidence. Without a clear model from which to work, in what direction should urban economics go? The discipline should begin to analyze the dynamics of edge cities, including the push and pull effects that impact their growth and development. The analysis should not be devoid of considerations of economic development planning and implementation, since governments are inevitably involved in their local economies. The basic question that urban economics should attempt to answer is what factors explain edge cities; why do they develop, and how do they interact?

In the urban economic field, classical theory from Christaller, Hotelling, von Thünen and others was the first wave, the NUE was the second, and the analysis of edge cities is now the third. It is important that economist develop away from the roots of the NUE and focus on more dynamic and less cities in order to understand the dynamics of the new, not the old.

Acknowledgement

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